Thermophysical Properties of Fluids From Dynamic Light Scattering (Invited)

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Dynamic light scattering (DLS) has evolved into a versatile and powerful technique for the determination of transport and other thermophysical properties of fluids from its continuous development for more than twenty years. The success is founded on its application in macroscopic thermodynamic equilibrium, i.e., without the need for employing external gradients, and in the large variety of properties, which can be derived, in some instances even simultaneously, by an appropriate experimental approach and a corresponding signal analysis.

The principles and variants of the technique are reviewed, and a survey on the determination of various desired properties, including thermal diffusivity, binary diffusion coefficient, viscosity, and sound velocity, is given. The stage of development and the corresponding uncertainties are discussed for the measurement of the individual quantities, and the performance of the method is demonstrated by representative experimental results. The presentation of the technique includes both the application of light scattering from bulk fluids and the variant of surface light scattering (SLS), which allows the measurement of kinematic viscosity and surface tension. Additionally, forced Rayleigh scattering (FRS), a related technique, which makes use of small induced gradients in the sample, is treated in a brief comparison.